U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject:	DYNAMIC EVALUATION OF SEAT RESTRAINT SYSTEMS & OCCUPANT RESTRAINT FOR ROTORCRAFT (NORMAL AND TRANSPORT)	**Date:** **Initiated by:**	3/30/92 ASW-110	**AC No:** **Change:**	20-137

1. PURPOSE. This advisory circular (AC) provides guidance regarding acceptable means, but not the only means, of compliance with Parts 27 and 29 of the Federal Aviation Regulations (FAR) applicable to dynamic testing of seats intended for use in normal and transport category rotorcraft.

2. RELATED FAR SECTIONS. FAR Sections 27.562, 27.785, 29.562, and 29.785 (Amendments 27-25 and 29-29; 54 FR 47310, 11/13/89).

3. READING MATERIAL. AC Nos. 23.562-1, Dynamic Testing of Part 23 Airplane Seat/Restraint Systems and Occupant Protection, 6/22/89, and 25.562-1, Dynamic Evaluation of Seat Restraint Systems and Occupant Protection on Transport Airplanes, 3/6/90. In addition SAE Aerospace Standard AS8049, "Performance Standard for Seats in Civil Rotorcraft and Transport Airplanes," issued July 1990, contains pertinent information. In the future, by notice and public procedure, the FAA intends to incorporate most of this AC material into AC Nos. 27-1, Certification of Normal Category Rotorcraft, and 29-2A, Certification of Transport Category Rotorcraft.

4. BACKGROUND.

a. Improved occupant restraint in civil rotorcraft is addressed in Amendments 27-25 and 29-29 to the airworthiness standards, which add two dynamic crash impact design conditions for seat and occupant restraint systems and which also increase the static design load factors for the occupant seating devices. These amendments also prescribe a shoulder harness for each occupant and adopt human impact injury criteria as a measure for occupant protection for the dynamic crash impact conditions. In addition, these amendments significantly improve occupant protection for normal and transport category rotorcraft in a survivable emergency landing. This advisory material addresses the dynamic test conditions and the related pass-fail injury criteria but not the static design standards. This material pertains to single as well as multiple seats and tandem arrangements of the seats in rotorcraft.

b. Dynamic test methods. This AC focuses on the use of dynamic test methods for evaluating the performance of rotorcraft seats, occupant and seat restraints, and certain related interior systems for demonstrating structural strength and the ability of those systems to protect an occupant from possible injuries in an emergency landing environment represented by the standard. These test methods differ from static test methods, which are limited to demonstrating only the structural strength of the seat or restraint system

under ultimate load for at least 3 seconds. This AC contains sources for appropriate test procedures and provides some insight into the logic of these procedures. It also defines, in part, a test facility and equipment characteristics necessary for conducting these tests.

c. Standardized test methods. Dynamic tests are quite often conducted at a specially equipped facility, one other than that owned by the designer or manufacturer of the test article. To obtain consistent test results, the applicant should specify the critical test procedures in detail in the test plan, and then carefully follow these procedures when conducting the tests. This AC defines certain critical procedures for accomplishing the tests of the seat and restraint systems and assessing the data obtained in the tests. Many of these procedures, also found in AC's 23.562-1 and 25.562-1, are accepted as standards by government and commercial test facilities and have been modified in this AC only as necessary for the specific testing of rotorcraft systems.

d. Relationship of dynamic tests to design standards. This AC describes test procedures useful in assessing the performance of a seat, restraint, and interior system. However, it is impractical to conduct sufficient tests for assessing the performance of the system throughout its entire range of possible uses in unique interior arrangements. The designer should not consider the tests described in this AC as sufficient to represent the entire range of performance expected of a system. The seat, restraint, and related interior system should be designed for the range of occupants and environments for which it is expected to perform, not just for the dynamic test conditions described in this AC. For example, the design should consider:

(1) Occupant size. The dynamic tests are conducted with a specific, acceptable, standard anthropomorphic test dummy (ATD) representing a 50th percentile male occupant. Energy absorbing systems, restraint system loads and anchorage locations, seat adjustments, seat pitch (for multiple seat rows), head strike envelopes, etc., are typical factors directly influenced by occupant size.

(2) Seat position and location. The tests should be sufficient to represent the range of performance expected of a seat and restraint system. A seat, especially an adjustable flight crew seat, should be qualified for those positions approved for take-off and landing. As with static test procedures the seat is also tested to the most critical condition for the dynamic tests. For an adjustable flight crew seat, as an example, the full-up position and longitudinal impact case are expected to be the critical condition. But these dynamic tests and occupant injury assessment provide a systems approach to qualification. It is therefore necessary to test adjustable seats at the "design" position for the ATD. Two tests would be required to demonstrate compliance with the strength standards and with the occupant injury criteria. Alternatively adjusting the flight crew seat to its highest position with the interior features, such as an instrument panel shield, raised to maintain the proper perspective or relation to the ATD, is considered an acceptable test procedure for demonstrating compliance with the structural and occupant injury

requirements for the seat and its location in a particular cockpit arrangement.

(3) Test conditions. Only two impact tests are described in the dynamic test procedures discussed in this AC. The test procedures address typical seat and restraint system installations. Other types of seat and restraint system installations may differ from the typical installation to the extent that additional tests may be required to demonstrate compliance. For example, while only one lateral load direction is specified in the tests, the system should perform properly when similarly loaded from either side.

(4) Floor deformation. While provision for evaluating the effect of certain sidewall or floor deformation is included in the tests, the seat and its attachments or restraint system should also perform properly if no floor deformation is present.

(5) Head impact. Should such contact occur, head impact with a seat back or the interior of the rotorcraft is evaluated by using a Head Injury Criterion (HIC), which can be measured directly in the tests discussed in this AC or in supplementary tests of the interior. The design of the interior should protect the head from serious injury throughout the head strike envelope, not just along the head strike paths demonstrated in the test conditions discussed in this AC.

(6) Emergency egress. Standards for emergency evacuation of the rotorcraft are contained in FAR Parts 27 and 29. The transport rotorcraft standards are more explicit than the normal category standards. The objective is to allow each occupant to leave the seat and rapidly evacuate the rotorcraft using an exit on either side of the rotorcraft.

(i) Transport category rotorcraft. Allowable permanent or residual deformation of the seat is specified in this AC. (Refer to § 29.785(j).) Safety belt and harness (i.e., torso restraints) are considered in evaluating compliance (§ 29.785(c)).

(ii) Normal category rotorcraft. Although allowable residual deformation is not specified herein, rapid egress shall be evaluated for the rotorcraft interior arrangement. Refer to §§ 27.785(c) and 27.785(j). The deformation for transport rotorcraft seats in this AC is relevant information.

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